Thai_BCAS

by Solikhah Solikhah

RESEARCH ARTICLE

Assessing Breast Cancer Awareness in Thai Women: Validation of the Breast Cancer Awareness Scale (B-CAS)

Nitchamon Rakkapao[1], Supannee Promthet[2], Malcolm Anthony Moore[3], Solikhah Solikhah[4], Cameron Hurst[5]*

Abstract

Background: Raising breast cancer awareness is a well-established first line strategy to reduce breast cancer mortality. A properly validated instrument is needed to gain a better understanding of breast cancer awareness. **Objective:** The objective of this study was to develop and validate an instrument to assess breast cancer awareness in Thai women. **Methods:** In this study, we develop and evaluate the validity of the Breast Cancer Awareness Scale (B-CAS). Construct validity was evaluated by using exploratory factor analysis and confirmatory factor analysis, and criterion validity was investigated using ROC curves to examine the associations between B-CAS subscales and breast self-examination. Internal consistency and test-retest reliability were also investigated. This validation process employed two independent samples of Thai women aged 20-64 years collected from communities in southern Thailand. **Results:** In total, 660 Thai women (mean age 41 years) participated in this study. Confirmatory factor analysis demonstrated the construct validity of B-CAS (CFI =0.91; NNFI=0.90; GFI=0.95; AGFI= 0.95; RMSEA=0.044, 95%CI 0.041 to 0.047; P< 0.05). Several of the B-CAS subscales demonstrated strong utility in discriminating between women who do and do not regularly conduct breast self-examination. B-CAS also demonstrated strong internal consistency (Cronbach's α=0.86) and test-retest reliability. The final version of B-CAS contains 35 items across five domains: knowledge of risk factors, knowledge of signs and symptoms, attitude to breast cancer prevention, barriers of breast screening, and health behaviour related to breast cancer awareness. **Conclusion:** The breast cancer awareness scale (B-CAS) was shown to have good psychometric properties in Thai women, and is likely to prove useful in studying the epidemiology of breast cancer awareness in Thai women, and evaluating breast cancer prevention programs for raising awareness.

Keywords: Instrument development- psychometric properties- breast cancer awareness- Thai women

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Introduction

Breast cancer is the most frequently diagnosed female cancer and the leading cause of cancer death in women worldwide (Jemal et al., 2011; Ferrat et al., 2012). Indeed, breast cancer represented a quarter (25%) of all new cancer cases in 2012, with most of these reported in developing countries (Ferlay et al., 2012). In Asia, breast cancer incidence is on the rise in many countries (Long et al., 2010; Moore, Ariyaratne et al., 2010; Moore, Attasara et al., 2010; Moore, Manan et al., 2010; Youlden et al., 2014), and consequently, increasing attention is being given to breast cancer awareness in women (Khokhar, 2009; Gurdal et al., 2012;Wu et al., 2012; Yoo et al., 2012; Donnelly et al., 2013; Miyawaki et al., 2014; Tazhibi and Feizi, 2014;). However, several studies have found that breast cancer awareness in Asian countries is generally weaker compared with western countries (Jones et al., 2010; Kwok et al., 2012). In Thailand, breast cancer has had higher incidence than any other cancer that affects women for the last decade. The National Cancer Institute of Thailand (NCI) reported that newly diagnosed breast cancer increased from 20.9 to 26.4 per 100,000 women during 2001 to 2009 (Khuhaprema et al., 2010; Khuhaprema et al., 2012; Khuhaprema et al., 2013). Moreover, women with breast cancer in Thailand tend to present with an advanced stage of the diseases (National Cancer Institute of Thailand, 2010-2012) leading to poor survival rates.

Delayed breast cancer diagnosis in developing countries is related to poor breast cancer awareness and barriers to health care services access (Akinyemiju, 2012; Tripathi et al., 2014; Unger-Saldana, 2014; Youlden et al., 2014). The World Health Organization (WHO) emphasizes that the most cost-effective long-term strategy for cancer control is prevention, and at least one-third of all cancer cases are preventable (WHO, 2002). Increasing breast cancer awareness is important in both primary and secondary prevention, and is widely accepted as the first step in the battle against breast cancer. It is essential to understand, and improve breast cancer awareness.

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A vital first step into understanding the epidemiology of breast cancer awareness is instruments to measure this construct and its associated factors. Only with such instruments can appropriate interventions to raise breast cancer awareness be designed and evaluated. Several instruments for assessing breast cancer awareness have been proposed (Linsell et al., 2010; Norlaili et al., 2013; Ranasinghe et al., 2013; Liu et al., 2014; Sathian et al., 2014). However, many of these instruments are not fully validated or involve methodological limitations making psychometric validation difficult, while others were developed for a particular healthcare setting and are unlikely to be valid, or even meaningful, outside of that setting. For example, Breast CAM, an instrument for measuring breast cancer awareness was developed for The United Kingdom (UK) setting and refers to UK-specific screening programs in its items. In addition, instruments developed for western population may not be valid in a developing country context. in general, or Asian developing countries, in particular. To the best of our knowledge, there is no broadly accepted instrument for assessing breast cancer awareness in Thailand, or any other Asian country. The aim of this study was to develop and validate an instrument to assess breast cancer awareness for Thai-speaking women. Also, unlike many previously developed instruments we will adhere to good practice in terms of the psychometric validation of this instrument.

Material and Methods

This study was conducted in two phases. The first phase involved the development of the items for a scale to measure breast cancer awareness (B-CAS) along with an exploration of its factorial structure. The second phase was concerned with establishing construct and criterion validity of the B-CAS, and an evaluation of how breast cancer awareness is associated with women's demographic characteristics.

Preliminary phase of instrument development

Content of the B-CAS instrument was developed based on both an extensive literature review, and semi-structured interviews of 15 women to identify potentially relevant items for the breast cancer awareness scale. An initial pool of items and their potential domains were evaluated by twelve experts who possessed extensive experience working in the breast cancer field. A pool of 58 items, distributed across five domains of breast cancer awareness was generated in this step. Content validity of the instrument was evaluated using the Content Validity Index (CVI) and CVI scores >0.8 were considered satisfactory (Polit and Beck, 2004). Five items were excluded due to low CVI and the remaining 53 items were grouped into five domains: knowledge of risk factors, knowledge of signs and symptoms, attitude to breast cancer prevention, barriers of breast screening, and health behaviour related to breast cancer awareness. With the exception to the barriers of breast screening domain higher values on all other four domains were desirable (suggesting better Breast Cancer Awareness). Items of knowledge domains were measured as yes/don't know/no, and items of attitude to breast cancer prevention and barriers of breast screening domains were rated on a 5-point Likert scale from strongly agree to strongly disagree, while health behaviour related to breast cancer awareness domain was represented as a five-point frequency scale (For example, How often do you exercise or play sport: every 1-2 days; every3-4 days; every 5-7 days; rarely; never). In addition, nine variables related to demographic information were collected in this study. The instrument then was trialed on 30 participants to assess face validity.

An exploration of the instrument structure was conducted in 209 women aged 20 to 64 years from the Surat Thani province, southern Thailand in August, 2015. Exploratory factor analysis suggested the retention of 32 items (factor loading >0.2), and a further three items were forced (despite low loading) into the model based on strong evidence of their importance in the literature. This provided an instrument with 35 items to be further validated (present study). Further details of these preliminary development steps can be found in Rakkapao et al., (2016).

Participants for the validation study

Thai women aged 20 to 64 years living in the community of either Surat thani or Songkla provinces of southern Thailand participated in this validation study. The questionnaire was administrated in October, 2015 to women with no history of breast cancer, not pregnant or breast feeding, and literate in the Thai language. In these two provinces of southern Thailand, stratified random sampling was used to select participants from rural and urban areas. Stratification was based on locality and age groups, and the sample size (n=660) was based on factor analysis to establish construct validity (Comrey and Lee, 1992). Permission to collect the data was obtained from the head of each community, and all participants provided informed consent. The study protocol was approved by the ethics committees of Khon Kaen University, Thailand (HE 582053).

Statistical analysis

Epidata version 3.1 (Lauritsen and Bruus, 2004) was used to enter the data, and the logic check mode was used to check for data errors. All analysis was conducted using the R statistics package (R CoreTeam v 2.3.0, 2015) and the R library lavaan was used for all factor analysis (Rosseel, 2012). Demographic information of the study participants were summarized using descriptive statistics. The construct validity of B-CAS was investigated using the Kaiser-Meyer-Olkin test (KMO), Barlett's test of sphericity and confirmatory factor analysis. The adequacy of the B-CAS measurement model was assessed using several fit indices, namely: Comparative Fit Index (CFI), Non-Normal Fit Index (NNFI), Root Mean Square Error of Approximation (RMSEA), Goodness Fit Index (GFI), and Adjusted Goodness Fit Index (AGFI). A model with NNFI (Hooper et al., 2008), CFI (Hu and Bentler, 1999), GFI (Shevlin and Miles, 1998) and AGFI (Byrne, 1994) > 0.9, and RMSEA <0.06 (Browne and Cudeck, 1993) was deemed to represent adequate model fit.

Criterion validity was assessed based on the B-CAS's ability to discriminant between women who did and did not regularly perform breast self-examination (measured concurrently). ROC curves along with the sensitivity, specificity, positive and negative predictive values, and positive and negative likelihood ratios were used to gauge the ability of the BCAS subscales to discriminate between women who do and do not perform breast self-examination. The ROC curves and corresponding statistics were generated using the R library Epi (Carstensen et al., 2014).

To assess reliability of the B-CAS instrument, test-retest reliability was investigated using the Intra-class correlation (ICC) and Bland-Altmnan plots using 60 women randomly selected from the full sample who were asked to repeat the questionnaire within one week. Internal consistency reliability was evaluated using Cronbach's alpha, and an acceptable reliability was considered to be α >0.7 for the all scales (Kline, 2013).

We also investigated how the individual BCAS subscales may vary with women's demographic characteristics. Each subscale was collapsed into a three-point ordinal scale with low (< mean - 1sd; approximately 16% of women), moderate (mean -1sd, mean + 1sd; approximately 68%) and high (>mean + 1sd; approximately 16%) categories. Proportional odds ordinal logistic regression was then used to examine the bivariate associations between the various breast cancer awareness factors, and women's characteristics .

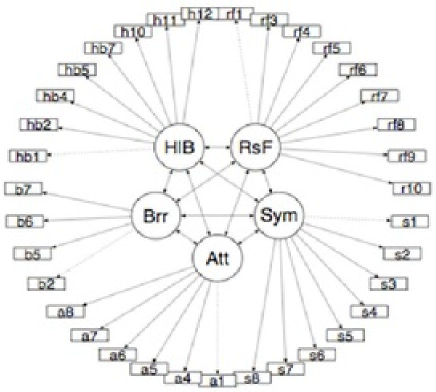

Figure 1. Measurement Model for the CFA of B-CAS

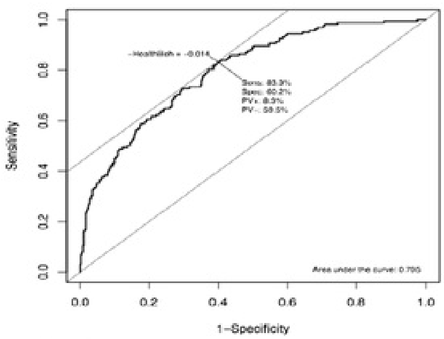

Figure 2. Receiver -Operator Characteristic Curve for the Health Behavior Subscale as Related to Breast Self-Examination

Results

Demographic characteristics of participants in validation study

A total of 660 Thai women completed the questionnaire (Response rate: 94.3%), and their ages ranged from 20 to 64 years old (Mean=41.38, SD=11.92). Over half of the participants were aged between 35 to 59 years old (54.85%) , had not achieved more than a high school

Table 1. Demographic Characteristics of Participants

Characteristics	n= 660	%
Age group		
Early adulthood (20-34 y)	237	35.91
Adulthood (35-59 y)	362	54.85
Elderly (60-64 y)	61	9.24
Education level		
Primary school	286	43.33
High School	211	31.97
Diploma or equal	53	8.03
Bachelor degree	103	15.61
Higher than Bachelor degree	7	1.06
Occupation		
Agriculture	264	40.00
Trader	158	23.94
Laborer	103	15.61
Government official/enterprise/business	63	9.55
Out of work	39	5.91
Other	33	5.00
Religion		
Buddhism	410	62.12
Muslim	247	37.42
Christian	2	0.30
Other	1	0.15
Marital status		
Single	108	16.36
Married/Partner	511	77.42
Widowed/Divorced/Separated	41	6.21
Family income		
Not enough and have debt	70	10.61
Not enough and no debt	37	5.61
Enough and no savings	365	55.30
Enough and have savings	188	28.48
Family history of cancer		
Yes	95	14.39
No	565	85.61
Family history of breast cancer		
Yes	17	2.58
No	643	97.42
Locality		
Rural	461	69.85
Urban	199	30.15

Table 2. Standardized Loadings of B-CAS from the Exploratory Factor Analysis (n=219) (Rakkapao et al., 2016) and Confirmatory Factor Analysis (n=660)

Domains / Items	Risk factors		Symptoms		Attitudes		Barriers		Health behavior	
Knowledge of risk factors (9)	EFA	CFA	EFA	CFA	EFA	CFA	EFA	CFA	EFA	CFA
- rf1 Family history of breast cancer	0.12*	0.61	-	-	-	-	-	-	-	-
- rf3 Using a contraceptive drug	0.58	0.64	-	-	-	-	-	-	-	-
- rf4 Using hormone replacement therapy	0.64	0.65	-	-	-	-	-	-	-	-
- rf5 Starting your period before 12 years of age	0.59	0.29	-	-	-	-	-	-	-	-
- rf6 Late menopause after 55 years of age	0.74	0.36	-	-	-	-	-	-	-	-
- rf7 Null parity/infertility	0.52	0.43	-	-	-	-	-	-	-	-
- rf8 Having your first child after the age of 30	0.43	0.44	-	-	-	-	-	-	-	-
- rf9 Eating diet high in fat	0.32	0.51	-	-	-	-	-	-	-	-
- rf10 Being overweight	0.32	0.43	-	-	-	-	-	-	-	-
Knowledge of signs and symptoms (8)										
- s1 Discharge or bleeding from your nipple	-	-	0.15*	0.71	-	-	-	-	-	-
- s2 Swelling of all or part of a breast or armpit	-	-	0.38	0.72	-	-	-	-	-	-
- s3 Changes in the shape, size and colour of your breast and nipple	-	-	0.75	0.57	-	-	-	-	-	-
- s4 Pain in one of your breasts or armpit	-	-	0.72	0.44	-	-	-	-	-	-
- s5 Pulling in of your nipple	-	-	0.7	0.66	-	-	-	-	-	-
- s6 A lump or thickening under your armpit	-	-	0.46	0.62	-	-	-	-	-	-
- s7 Puckering or dimpling of your breast skin	-	-	0.78	0.75	-	-	-	-	-	-
- s8 A lump or thickening in your breast	-	-	0.17*	0.68	-	-	-	-	-	-
Attitude to breast cancer prevention (6)										
- a1 I think that breast cancer can be prevented by decreasing risk factors of breast cancer.	-	-	-	-	0.42	0.51	-	-	-	-
- a4 I think that breast cancer is curable if I can detect it at early stage.	-	-	-	-	0.59	0.6	-	-	-	-
- a5 I think that performing frequent examinations with health personnel can detect breast cancer	-	-	-	-	0.71	0.72	-	-	-	-
at an early stage										
- a6 I think that performing mammography frequently can detect breast cancer at an early stage.	-	-	-	-	0.8	0.58	-	-	-	-
- a7 I think that exercise can decrease breast cancer risk.	-	-	-	-	0.87	0.75	-	-	-	-
- a8 I think that decreasing a high fat diet can decrease breast cancer risk.	-	-	-	-	0.82	0.77	-	-	-	-

Table 2. Continued

Domains	Items	Risk factors		Symptoms		Attitudes		Barriers		Health behavior	
		EFA	CFA	EFA	CFA	EFA	CFA	EFA	CFA	EFA	CFA
Barriers of breast screening (4)											
- b2	It is not convenient for me to see a doctor for a breast screening.	-	-	-	-	-	-	0.62	0.61	-	-
- b5	I think that it takes too long to wait to see a doctor for a breast screening.	-	-	-	-	-	-	0.44	0.46	-	-
- b6	I am busy and I have no time to see a doctor for a breast screening.	-	-	-	-	-	-	0.73	0.74	-	-
- b7	I do not know how to perform a breast self-examination	-	-	-	-	-	-	0.56	0.68	-	-
Health behavior related to breast cancer awareness (8)											
- hb1	+How many days per week do you eat fried food?	-	-	-	-	-	-	-	-	0.58	0.45
- hb2	+How many days per week do you eat food or dessert with coconut?	-	-	-	-	-	-	-	-	0.52	0.49
- hb4	+How often do you eat beef, chicken, or duck with the fat or skin?	-	-	-	-	-	-	-	-	0.39	0.48
- hb5	How many days per week do you eat fresh vegetables?	-	-	-	-	-	-	-	-	0.35	0.25
- hb7	How many days per week do you exercise or play sports?	-	-	-	-	-	-	-	-	0.44	0.55
- hb10	Have often do you heard about the breast screening policy from the health personnel in your area?	-	-	-	-	-	-	-	-	0.48	0.61
- hb11	How often do you perform a clinical breast screening?	-	-	-	-	-	-	-	-	0.38	0.65
- hb12	How often do you perform a mammogram?	-	-	-	-	-	-	-	-	0.21	0.18

*, low loading items that were forced in CFA; +, Reverse scored items

Table 3. Inter-Factor Correlation of B-CAS*

	Symptoms	Attitude	Barriers	Heath behavior
Risk factors	0.513	0.272	-0.222	-0.299
Symptoms	-	0.295	-0.45	0.119
Attitude	-	-	-0.143	0.23
Barriers	-	-	-	-0.443

* All inter-factor correlation were statistically significant ($p<0.05$)

education (75.3%), and resided in rural areas (69.85%). The demographic characteristics of the participants are presented in Table 1.

Construct validity

The KMO statistic was 0.84 suggesting that the dataset was suitable for factor analysis, and Barlett's test of sphericity was highly significant (CHISQ=7,893, df= 595, $p<0.001$) indicating it was highly unlikely that the individual items are not inter-correlated. The B-CAS measurement model was represented by 35 items distributed across five factors, and was fit using an Unweighted Least Squares Confirmatory Factor Analysis. Based on the five pre-established criteria (CFI, NNFI, RMSEA, GFI, and AGFI fit indices), the model showed adequate fit to the data (CFI =0.91, NNFI=0.90, GFI=0.95, AGFI= 0.95 and RMSEA=0.044, 95%CI 0.041 to 0.047; $P< 0.05$). The measurement model for the CFA is shown in Figure 1. All items in the model loaded significantly at the 0.001 level on their respective factors as shown in Table 2. Detail of exploratory factor analysis (reproduced from Rakkapao et al., 2016) and confirmatory factor analysis loadings are presented in Table 2.

A large majority of the loadings changed little between the exploratory factor analysis and confirmatory factor analysis. The exceptions to this were the items that were forced into the CFA which despite low loadings in the EFA, loaded substantially higher in the CFA.

Inter-factor correlations among the B-CAS subscales are given in Table 3. Inter-factor correlations were moderately positively associated between knowledge of breast cancer risk factor and knowledge of signs and symptoms of breast cancer (Table 3). In contrast, the barrier subscale was moderately negatively associated with both the knowledge of signs and symptoms and health behavior related to breast cancer awareness.

Criterion validity

Criterion validity of the B-CAS subscales was evaluated in terms of the sub-scales' ability to discriminate between women who do, and do not regularly conduct breast self-examination (measured concurrently). Receiver operating characteristic (ROC) curves were generated for all subscales. Table 4 provides the sensitivity, specificity, positive and negative predictive values, and the positive and negative likelihood ratios associated with each B-CAS subscale. All five subscales show at a strong ability to identify those who do not perform breast self examination (Sensitivities ranging from 65.4% to 83.3%) and all subscales except knowledge of risk factors show at least moderate accuracy in identifying those who do breast self examine (Specificities ranging from 58.2-70.7). The domain, Health behaviour related to breast cancer awareness, in particular, showed strong accuracy at identifying women who do, and who do not, perform breast self examination. Figure 2 demonstrates the ability of the health behaviour subscale to discriminate between women who perform and do not perform breast self-examination.

Reliability analyses

Perusal of the results of the intraclass correlation analysis for the individual subscales suggests strong test-retest reliability for all subscales (Table 5) except attitude to breast screening which demonstrated poor temporal stability (ICC=0.340, 95% CI 0.10 to 0.54). To investigate this lack of reproducibility of the attitude subscale, the Bland-Altman plot was generated (result not shown) demonstrating that a large majority of participants fell within the limits of agreement and an average difference (baseline vs repeated measure) close to

Table 4. Sensitivity, Specificity, Positive Predictive Values (PPV) and Negative Predictive Values (NPV), and the Positive and Negative Likelihood Ratios (LR+ And LR-) of the B-CAS Subscale to Distinguish between Women who Do and Do not Regularly Perform Breast Self-Examination

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	LR+	LR-
Risk factors	69.1	33.5	23.0	74.7	1.04	0.92
Sign and symptom	72.2	58.2	13.4	64.0	1.73	0.48
Attitude	67.3	60.4	15.0	64.4	1.70	0.54
Barrier	65.4	70.7	13.7	57.9	2.23	0.49
Health behavior	83.3	60.2	8.3	59.5	2.09	0.28

Table 5. Intraclass Correlation Coefficient (ICC) and Cronbach's Alpha of Each B-CAS Subscale

Scales	ICC	95%CI	Cronbach's alpha
Knowledge of risk factors	0.801	0.69,0.88	0.834
Knowledge of signs and symptoms	0.786	0.67,0.87	0.846
Attitude to breast cancer prevention	0.34	0.10,0.54	0.818
Barriers of breast screening	0.978	0.96,0.99	0.838
Health behavior related to breast cancer awareness	0.978	0.98,0.96	0.743

Table 6. Unadjusted Associations of Demographic Characteristics with the Five B-CAS Subscales as Represented by Odds Ratios from Bivariate Proportional Odds Ordinal Logistic Regression Analysis.

Effects	Health behavior	Risk factors	Symptoms	Attitude	Barriers
Age (10yrs)	1.33*** (1.17,1.53)	1.01(0.89,1.15)	1.21(0.99,1.46)	1.01(0.88,1.14)	0.82***(0.71,0.94)
Area (rural)	6.04*** (4.10,8.90)	0.47***(0.33,0.66)	0.89(0.55,1.46)	0.75(0.53,1.04)	0.45***(0.31,0.64)
Education	χ 2LRT = 8.89917***	χ 2LRT = 0.98906	χ 2LRT = 4.24511	χ 2LRT = 2.4787	χ 2LRT = 11.548 *
High School	2.14**(1.47,3.13)	1.01(0.70,1.44)	1.23(0.73,2.09)	1.21(0.85,1.74)	0.56*(0.37,0.82)
Diploma or equal	2.23**(1.23,4.06)	0.80(0.45,1.42)	2.00(0.71,5.66)	1.50(0.82,2.74)	1.19(0.63,2.22)
Bachelor degree	1.41(0.89,2.26)	1.11(0.70,1.75)	0.85(0.46,1.57)	1.23(0.77,1.96)	0.81(0.50,1.32)
Higher than Bachelor	0.96(0.23,4.12)	1.07(0.21,5.42)	0.42(0.08,2.24)	1.01(0.22,4.46)	1.86(0.42,8.22)
Occupation	χ 2LRT = 21.23538***	χ 2LRT = 10.43227 *	χ 2LRT = 14.53313 *	χ 2LRT = 5.76328	χ 2LRT = 19.6626 **
Trader	0.50**(0.33,0.76)	0.97(0.65,1.45)	1.42(0.73,2.77)	1.24(0.84,1.85)	1.33(0.86,2.05)
Laborer	0.47**(0.29,0.77)	0.61*(0.39,0.96)	0.48*0.26,0.87)	0.80(0.50,1.27)	3.02***(1.84,4.97)
Government official	1.03(0.59,1.78)	0.54*(0.31,0.97)	0.46*(0.23,0.92)	0.91(0.51,1.62)	1.52(0.83,2.78)
Unemployment	0.48*(0.24,0.94)	0.60(0.31,1.17)	0.60(0.24,1.46)	0.65(0.32,1.31)	1.77(0.87,3.60)
Other	0.40*(0.19,0.82)	1.26(0.60,2.67)	1.28(0.38,4.34)	0.70(0.34,1.45)	1.59(0.72,3.53)
Religion (Other)	1.28 (0.92,1.76)	0.58***(0.42,0.80)	0.94(0.59,1.47)	1.07(0.78,1.47)	1.28(0.91,1.80)
Marital status	χ 2LRT = 4.01137	χ 2LRT = 18.48199	χ 2LRT = 11.20629 **	χ 2LRT = 1.2986	χ 2LRT = 0.30935
Married	0.82 (0.53,1.28)	1.72*(1.12,2.64)	2.41**(1.43,4.07)	1.27(0.82,1.94)	0.93(0.59,1.46)
widowed/di vorced/separated	1.54 (0.74,3.23)	0.51(0.25,1.03)	1.24(0.51,3.02)	1.07(0.50,2.30)	1.10(0.51,2.40)
Income(sufficiency)	χ 2LRT = 25.63971	χ 2LRT = 5.18046	χ 2LRT = 0.8447	χ 2LRT = 4.3877	χ 2LRT = 1.85962
No saving	0.62*(0.43,0.89)	0.74(0.52,1.06)	0.96(0.57,1.62)	0.72(0.51,1.04)	0.95(0.66,1.39)
No debt	2.51**(1.25,5.03)	0.55(0.26,1.17)	0.94(0.34,2.62)	1.15(0.56,2.35)	0.58(0.26,1.28)
Have debt	1.54 (0.89,2.66)	0.60(0.34,1.04)	0.71(0.34,1.51)	0.72(0.41,1.26)	0.96(0.54,1.71)
Family history of cancer(Yes)	1.17 (0.75,1.82)	0.72(0.46,1.12)	0.41*(0.18,0.94)	1.21(0.77,1.90)	1.34(0.85,2.13)
Family history of BC (Yes)	0.75 (0.26,2.13)	1.38(0.53,3.61)	0.85(0.20,3.73)	2.50(0.97,6.41)	1.29(0.46,3.63)

Note; ***, p<0.001; **, p<0.01; *, p<0.05

zero suggesting little evidence of bias. This indicates that the limited reproducibility of attitude to breast screening subscale is likely due to noise.

Internal consistency reliability analysis demonstrated that the B-CAS achieved a good level of internal consistency reliability with a Cronbach's alpha of 0.855 for the overall scale, and values ranging from (0.75-0.85) for the subscales. Table 5 provides evidence of both test-retest (ICC) and internal consistency reliability (Cornbach's alpha) associated with each of the B-CAS subscales.

Breast cancer awareness and demographic characteristics

Each subscale was collapsed into a three-point ordinal scale representing low, moderate and high levels of each construct. Bivariate proportional odds ordinal logistic regression was then performed and the crude odds ratios are provided in Table 6.

Perusal of Table 6 indicates that there were several demographic characteristics associated with BCA subscales, although none were associated across all subscales. It is noteworthy, that subscales that shared associations with Barriers were usually in the opposite direction. For example, Labourers, who had lower odds of better health behaviour (OR=0.47; 95%CI: 0.29, 0.77; $p<0.001$), knowledge of risk factors (OR=0.61; 95%CI:0.39,0.96; $p<0.05$) and knowledge of symptoms (OR=0.48; 95%CI:0.26, 0.87; $p<0.01$) relative to farmers, had higher odds of experiencing barriers (OR=3.02; 95%CI:1.84, 4.97, $p<0.001$). This result is not surprising as higher scores for all other subclass (Behavior, Knowledge of Risk factors, Knowledge of Symptoms, and Attitudes) is desirable, while higher levels of barriers is undesirable. Neither Family history of Cancer or Family history of Breast cancer were associated with any of the scales except knowledge of symptoms, where those with a family history of breast cancer showed substantial lower odds higher knowledge of symptoms; women with a family history of breast cancer had 59% less the odds of better knowledge of symptoms (OR=0.41; 95%CI: 0.18, 0.94; $p<0.05$). Also worth noting is that while all other subscales show associations with demographic characteristics (although somewhat inconsistently), none of the demographic characteristics we considered in this study could be shown to be associated with attitude to breast cancer prevention.

Discussion

Unlike many developed countries where comprehensive screening programs and developments in treatment have made major inroads in reducing BC mortality, many developing Asian countries, despite having lower breast cancer incidence, have alarmingly high breast cancer mortality (Jemal et al., 2011; Youlden et al., 2012). This higher case fatality rate is likely to be the result, at least in part, to the later detection of cases that might otherwise be detected under a system of comprehensive community screening. In such resource poor health care settings, breast cancer prevention though raising breast cancer awareness is likely to prove one of the most effective strategies for reducing breast cancer mortality control as it is primarily concerned with preventing the onset of disease, and detecting the disease in its earliest stages. Awareness of breast cancer can lead to desirable protective behavior, such as self-screening, and motivating women to seek clinical examination. This provided the primary motivation for this study to develop an instrument to assess breast cancer awareness, especially in a developing Asian country context, where to date, no validated instruments have been developed. We feel the breast cancer awareness scale (B-CAS) will lead to a better understanding of the epidemiology of breast cancer awareness, identifying those at risk for poor breast cancer awareness, and also provide a tool to evaluate educational interventions to reduce breast cancer incidence and mortality.

Awareness of breast cancer is affected by many factors, and there are difficulties in measuring this construct. Although several studies have developed instruments attempting to measure breast cancer awareness, these instruments typically focus on specific populations and on health care settings with comprehensive mammographic screening programs (Cancer Research United Kingdom, and King's College London, and University College London, 2009). Perhaps more importantly, most instruments developed are far from fully validated and many have design limitations making their validation difficult. (Norlaili et al., 2013; Elobaid et al., 2014; Liu et al., 2014; Sathian et al., 2014).

In this study, we developed the B-CAS to evaluate the level of breast cancer awareness in Thai women. The items of the B-CAS were generated in order to cover most key aspects of breast cancer awareness including knowledge, attitude, barriers, and behavior. Specifically, the 35 items of the B-CAS are distributed across five subscales: knowledge of risk factors, knowledge of signs and symptoms, attitude to breast cancer prevention, barriers of breast screening, and health behavior related to breast cancer awareness. Our results demonstrate that the B-CAS has desirable psychometric properties and can be used to assess breast cancer awareness in Thai women. To the best of our knowledge, B-CAS represents the first instrument developed and validated to measure breast cancer awareness in Thai women, and indeed, the first BCA instrument to be comprehensively validated in any population. In addition, B-CAS was designed for easy administration including a short completion time and suitability for either self-report or interviewer administration. Furthermore, in the design of B-CAS we intentionally omitted items and domains that are specific to a particular healthcare setting, and avoided items that might be culturaly specific. We believe these design considerations will lead to stronger cross-cultural validity than instruments that have been developed with particular health care settings in mind.

We also demonstrate that B-CAS was strongly concurrently associated with breast self-examination; a property that is particularly important in the South-east Asian context where community-based screening programs are either absent, or are nowhere near as well resourced as in developed countries. Although the ability of breast self-examination to reduce breast cancer mortality has not been reported (Thomas et al., 2002; Hackshaw and Paul, 2003; Semiglazov et al., 2003; McCready et al., 2005), most studies on the efficacy of breast self examination for early detection of breast cancer have been conducted in western countries, which typically have well funded and comprehensive breast cancer screening programs. In resource-poor health settings where no such screening programs exist, it is more likely to be the individual, rather than health care provider, which is the main agent motivating clinical examination or mammography. Furthermore, the practice of breast self-examination has been seen to empower women to take responsibility for their health, and raise awareness for breast cancer (McCready et al., 2005).

Our results show that inter-factor correlations among the B-CAS subscales illustrate that barriers of breast screening was moderately negatively associated with both the knowledge of signs and symptoms and health behaviour related to breast cancer awareness. We also observed that many factors that were negatively associated with the other subscales (Lower chance of desirable behaviour, knowledge of risk factors and symptoms), were accompanied with higher level of perceived barriers. This result is consistent with a study by Ferrat and colleagues that reported non-users of organised or opportunistic screening exhibited doubts about the usefulness of screening, found the nature of organized programs to be impersonal, and/or had had previous negative experiences of mammography (Ferrat et al., 2013). It seems logical that women who don't acknowledge the efficacy of breast cancer screening and/or who have had negative previous experiences regarding clinical breast examination are likely to exhibit higher perceived barriers.

There were also some surprising results regarding other demographic associations. For instance, while rurality was strongly associated with a poor knowledge of risk factors, it was also associated with substantially higher odds of better behaviour, suggesting that this better behaviour (at least in rural women) is not related to their knowledge and attitudes toward breast cancer. This is in sharp contrast to Kanaga (2011) and Muthoni (2010) who found that women in rural areas not only exhibit poor knowledge of breast cancer, but this is accompanied by poor breast cancer behavior. Finally, we were surprised to observe that a family history of breast or other types of cancer, for the most part, could not be shown to be associated with the B-CAS subscale. However, it should be noted that the number of participants in our study, with a family history of breast cancer, was quite small (2.58%). Interestingly, we observed that family history of (any) cancer was strongly negatively associated with better knowledge of symptoms.

The present study did have some limitations. First, we included women only from the south of Thailand, therefore the representativeness of this sample for all Thai women or indeed those from other Southeast Asia countries is not known. Second, we could not assess the convergent validity of B-CAS as there is currently not a generally accepted instrument for measuring breast cancer awareness in our target population. Third, our criterion validation of B-CAS was restricted to demonstrating concurrent association of the B-CAS subscales and breast self-examination. This was due to the cross-sectional nature of our study design. Demonstrating B-CAS to be predictive of (future) BSE would provide stronger evidence of criterion validity. Finally, associations between the B-CAS and demographic characteristics were confined to bivariate analyses. We felt that a comprehensive multivariable modelling to obtain adjusted associations was not within the scope of the present study, and have left this for a further study.

Our study also had some major strengths, First, the development of our instrument, and its subsequent psychometric validation was more comprehensive than any previously developed BCA instruments. A majority of breast cancer awareness instruments fall short in this regard, particularly in the construct and criterion validation phases. For instance, few BCA measurement instrument studies have conducted factor analysis to either empirically justify, or construct validate their reported domains. Our study involved a comprehensive assessment of the validity and reliability with an appropriate sample. Third, this study was carried out using a relatively large sample of the general Thai women population, covering a comparatively wide spectrum of socio-demographic circumstances.

This study developed an instrument, the Breast Cancer Awareness Scale (B-CAS) to assess breast cancer awareness in the general Thai women population. We demonstrate the B-CAS has good psychometric properties, and is an appropriate instrument for assessing breast cancer awareness in Thai women. We also developed the instrument to be easily adapted for similar cultures and/or health care settings, and we believe that it is likely to be useful in other countries, especially in Southeast Asia. We believe this instrument will provide valuable insights into to the epidemiology of breast cancer awareness among Thai and other Southeast Asia women, and is likely to demonstrate utility in evaluating interventions attempting to raise breast cancer awareness.

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